Source process of the 14 April 2016 earthquake (M6.5) in Kumamoto area estimated by back-projection analysis

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The series of seismic activity of the 2016 Kumamoto earthquake began on April 14, with an M6.5 earthquake. There occurred many earthquakes, including an M7.3 earthquake on April 16, followed by three earthquakes of magnitude about 6 on April 16 alone. In this study, the fault rupture process of the M6.5 earthquake on April 14 was estimated by the back-projection method using local strong motion records. In back-projection method, the spatio-temporal distribution of the radiation intensity of seismic waves is obtained, so that the spatio-temporal evolution of the fault rupture can be investigated. With the back-projection method, it is possible to capture the fault rupture process in a higher frequency band than the waveform inversion that is usually performed in frequency of about 0.1 to 1 Hz. Accumulation of analysis of fault rupture processes by the back-projection method are to contribute to the construction of a broadband fault model for ground motion prediction.
For the analysis, the strong motion records of KiK-net underground stations around Kumamoto area were used. The seismograms were corrected for the orientation of the seismometers, removed the offset, and integrated once to obtain the velocity waveform. In the back-projection method, it is not necessary to set the fault plane in advance, however, from the viewpoint of computational efficiency, the fault plane was set in this study. For this earthquake, waveform inversion has already been performed, and the fault plane used for the waveform inversion was also used in the back-projection. The travel time data used for the back-projection method were the observed travel times obtained by Matsubara et al. (2018) using hypocenter relocation using the double-difference method. By spatially interpolating the travel time of near fault plane events, the travel time among the grids on the fault plane and the strong motion stations were obtained. In the spatial interpolation of the travel time data, the values of the free parameters of the interpolation formula were set by performing statistical investigations so as to minimize the interpolation error. Furthermore, the accuracy of the relative position of the seismic wave radiation intensity to the epicenter was improved by performing travel time data processing similar to Takenaka and Yamamoto (2004). The strong motion stations were divided into multiple groups according to the positional relation with the fault plane, back-projection was performed for each group, and the rupture images obtained for each group were integrated to obtain the final rupture image. The integration of multiple back-projection images was performed in consideration of the direction of arrival of the seismic waves.
Our presentation will show the data used, the method, and the fault rupture process of the April 14, 2016 earthquake (M6.5) estimated by the back-projection method.

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Keywords: The 2016 Kumamoto earthquake, the earthquake occurred on 14 April, 2016, back-projection method

